REFLECTION SEISMIC IMAGING IN THE ZINKGRUVAN MININING AREA, CENTRAL SWEDEN

Alba Gil[1*], Alireza Malehmir[1], Stefan Buske[2], Juan Alcalde[3], Louise Lindskog[4], Bill Spicer[5], Ramon Carbonell[3], Dirk Orlowsky[6], Matthew Penney[5] and Anja Hagerud[4]

[1]Department of Earth Sciences, Uppsala University, Sweden, [2]Technische Universität Bergakademie Freiberg, Germany, [3]Institute of Earth Sciences Jaume Almera (ICTJA-CSIC), Spain, [4]Zinkgruvan Mining AB, Sweden, [5]Lundin Mining Corporation, Canada, [6]DMT GmbH & Co, Germany
*(alba.gil@geo.uu.se)

Bergslagen in central Sweden is one of the three most mineral prospective regions in the country. In November 2018, a dense multi-method seismic dataset was acquired in the Zinkgruvan mining area (located in the southern Bergslagen district), in a joint collaborative approach among Swedish, Spanish and German institutes under an up-scaling EIT Raw-Materials funded project called SIT4ME (Seismic Imaging Techniques for Mineral Exploration). A dense array of 2D profiles in an area of approximately 6 km^2 was acquired using a 32t seismic vibrator (10–150 Hz) of TU Bergakademie Freiberg, enabling reasonable 3D sub-surface illumination. For the data acquisition, a total of approximately 1300 receiver positions (10-20 m apart), using different recorders, and 950 source positions were surveyed. Acquisition time and logistics were considered when designing the setup. All 2D profiles were active during the data acquisition allowing a combination of 2D and semi-3D data to be obtained for various imaging and comparative studies. The main objective of the study, apart from its commercial-realization approach, was also to provide information useful for deep-targeting and structural imaging in this complex geological setting.

Although the seismic data were acquired during a rainy period and with high background noise levels due to the underground mining activities, notable reflections are observed on several shot gathers illustrating the good quality of the data. Following a tailored for hard rock processing approach, the resulting seismic sections show numerous reflections with various dips and character. Given the crookedness of the profiles, forward 3D reflection traveltime modelling was performed to make sure that the true geometry of the reflections is captured from one profile to another. Borehole data were obtained and provided further assistance for the interpretation of the seismic data. Most of the steeply dipping reflections are relatively easy to interpret when projected to surface and compared with the existing surface geological map of the study area. They are primarily from the fault systems in the area, although lithological sequences are also observed. The main massive-sulphide bearing horizon, Zinkgruvan formation, is strongly reflective as correlated with the existing boreholes in the mine. Careful analysis of the seismic sections suggests a dominant northeast-dipping structure, consistent with the general plunge of the main Zinkgruvan folds that have been mapped in the area. This is important as it will help define regions and depths that may be highly prospective for deep-seated massive sulphide deposits in the area.